GWANDA STATE UNIVERSITY

FACULTY OF LIFE SCIENCES

DEPARTMENT OF CROP SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE IN CROP SCIENCE

LCS 1104 INTRODUCTION SOIL SCIENCE

FIRST SEMESTER EXAMINATION

January 2021

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Special Requirements: **Calculator**

Examiner's Name: **Mathema. N**

INSTRUCTIONS

1. Answer **all** questions in Section A

2. Answer **only two** questions in Section B

MARK ALLOCATION

QUESTION	MARKS
SECTION A	60
SECTION B	40
TOTAL ATTAINABLE MARKS	100

Question 1

A farmer took his three soil samples to a laboratory and obtained the following data:

Soil texture: soil sample A = 95% sand, 5% silt and 5% clay

Soil texture: soil sample B = 15% sand, 15% silt and 70% clay

Soil texture: soil sample C = 35% sand, 35% silt and 30% clay

Bulk density: soil sample A = 1500kg m^{-3}

Bulk density: soil sample B = 1100kg m^{-3}

Bulk density: soil sample C = 1300kg m^{-3}

a) Determine the type of soil for each of the three soil samples (A, B and C) using the texture triangle [3]

b) Assuming that particle density for each soil sample is equal to 2600kgm^{-3}. Calculate the % porosity for each of the soil samples? [10]

c) From the results obtained in part b) explain the relationship between bulk density and porosity. [2]

d) Explain the difference in soil porosity between soil sample A and B [5]

Question 2

a) Describe the following processes in soils noting climatic regions where they are most prominent:

i) Ferrallitization [5]

ii) Podzolization [5]

iii) Gleying [5]

iv) Salinisation [5]

Question 3

a) Describe two mechanical methods of managing soil erosion [4]

b) Illustrate the usefulness of the following management practices when used to control soil temperature:

   i. Tillage [3]

   ii. Organic mulches [3]

   iii. Irrigation and drainage [4]

c) i. Explain the reasons for classifying soils [3]

   ii. Outline what you understand by fersiallitic group. [3]

SECTION B: ANSWER ANY TWO QUESTIONS IN THIS SECTION

Question 4

    a) Define Cation exchange capacity [1]

    b) Outline the sources of negative charge in soils [7]

    c) Illustrate any four (4) causes of Salinity in Agricultural soils, two (2) must be from non-irrigated and two (2) from irrigated lands [12]

Question 5

    a) Outline the structure of the following Alumino-silicate clays, clearly stating the; ratio of Octahedral to tetrahedral sheets, presence or absence of hydrogen bonding between layers, surface area, and swelling due to water absorption:

        i. Kaolinite [3]

        ii. Montmorillonite and vermiculite [3]

        iii. Hydrous Mica [3]

        iv. Chlorites [3]

    b) Using your knowledge of Aluminosilicate clays, explain why Vermiculite is used as one of the materials for preparing seedling growth medium. [2]

    c) Discuss why the red soils found around Filabusi and Harare are of less value to farmers than the black soils found in Nyamandlovu or Chisumbanje under the following headings;

        i) Reactions leading to their formation [2]

        ii) Types of clays [2]

        iii) Nutrient and water holding capacity [2]

Question 6

    a) You have been assigned to irrigate a Maize crop and obtained the following data for your soil profile:

Soil Horizon	A	B1	B2
Horizon/Root depth (mm)	0-150	150- 400	400- 900
Wilting point (mm mm^{-1})	0. 15	0.21	0. 19
Field capacity (mm mm^{-1})	0. 35	0.46	0.39

     i.   Calculate the AWC (Available Water Capacity) of each horizon in mm 100 mm^{-1} [2]

    ii.   Calculate the PAW of each horizon   [3]

    iii.   Calculate the total PAW in all three horizons   [3]

b) Briefly Outline the difference in frequency of irrigation cycles between light and heavy textured soils   [2]

c) 'It is vital for a farmer to manage the Carbon to Nitrogen ration of his/her soil'. Justify this statement giving examples.   [10]

Question 7

Outline the factors that affect soil bulk density under the following headings;

a) Texture   [5]

b) Packaging of particles   [6]

c) Organic matter   [3]

    Compaction   [6]

END OF EXAMINATION PAPER